National Capital Region
National Park Service

Deer Survey Report
Fall 2005

Antietam National Battlefield
Catoctin Mountain Park
Chesapeake and Ohio Canal National Historic Park-Gold Mine Tract
Greenbelt Park (NACE)
George Washington Memorial Parkway-Great Falls
Manassas National Battlefield Park
Monocacy National Battlefield
Piscataway Park (NACE)
Prince William Forest Park
Harpers Ferry National Historic Park
Rock Creek Park

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ANNUAL REPORT CHECKLIST

X Cover page lists all authors and addresses.
X Document has been reviewed for content, spelling, and grammar.
X Abstract and keywords are provided on page three of final report.
X Body of document includes introduction, description of study area, methods, results, and discussion.
X Conclusion Section includes Public Interest Highlights.
X Conclusion Section includes Management Recommendations.
X Conclusion Section includes Research Recommendations.
X Tables, figures, maps, and illustrations have descriptive titles and are sequentially numbered.
X Document is supported by scientific literature.
X Literature Cited has been checked against the text.

ABSTRACT

The results of the 6th annual fall deer survey results are presented. The purpose of the survey is to assess densities and trends of white-tailed deer populations at natural and cultural resource parks. Distance Sampling is used at all parks except HAFE, where pellet-group counts are used. In 2005, 7 out of the 11 parks surveyed had decreases in density when compared to 2004. MONO, GREE, CATO, and ROCR had decreases that were 20% less than their 2004 densities. Four parks (GWMP, HAFE, CHOH, PISC) saw increases in 2005. HAFE and GWMP had significant increases over their 2004 densities. There were no significant trends at the 0.01 level. All parks except PRWI and GREE had deer densities over 40 deer per square mile. All parks with high deer densities have implemented or completed deer impact studies.

Keywords: Distance, white-tailed deer, sampling variation, and process variation.

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INTRODUCTION

Distance surveys and pellet-group surveys to determine densities of white-tailed deer (*Odocoileus virginianus*) started in the fall of 2000 and spring 2001 within the National Capital Region (NCR). Distance surveys were conducted at ANTI, CATO, CHOH, GREE, GWMP, MANA, MONO, PRWI, and ROCR. Pellet-group surveys were conducted at HAFE. These surveys are being conducted as part of a continuing effort to assess the deer population and its effect on NCR parks. Density data will be used in compiling deer management plans. This report summarizes the results of these surveys from their inception through the fall of 2005.

METHODS

Field methods for collecting Distance data and analyzing the data followed NCR Distance Protocols described in the monitoring plan for the region (NPS 2005) . All analyses were done at CUE. Spotlight data was entered into Distance software. Most parks were surveyed for at least three nights. Exceptions this year included GREE (4), ROCR (4), and MANA (1). Each night was treated as a replicate and the data were pooled for analysis. For the initial analysis, the detections were divided into 10-12 evenly-divided distance intervals. Intervals were expanded, narrowed, or dropped from the analysis to produce a smooth shoulder as the distance from the observer to the deer increased. Once a satisfactory shoulder was produced, four models were fit to the data (uniform, half-normal, hazard rate, and negative exponential). The three criteria used to choose the best fitted model were: 1) percent coefficient of variation (CV) less than 20; 2) the detection probability variation was less than 30%; 3) lowest Akaike's Information Criterion (AIC) score. Program Distance calculates all three measures.

Forty-five pellet-group plots were checked in the Maryland Heights section of HAFE (one per every 15 acres). The plots are 44-inch circular (1/1000 acre) plots. Deer pellets were removed in December and early January. Plots were checked for deer pellet-groups (group $\geq$ 5 pellets) 90 or 91 days later.

Program TRENDS (Gerrodette 1987) was used to calculate the power of the test to detect a trend in the deer population. TRENDS is a software program that gives power estimates using appropriate tests. This is important since we want to be able to guard against not being able to detect a change in the population when it actually has occurred (a Type II statistical error). At a minimum we would like to be able to have an 80% chance to detect a 10% increase or decrease in the deer population. Wide variations in the number of deer groups encountered during the survey are the main reason why a survey would have low power.

The mean fall CV from Distance was used as an input into Dr. Underwood's Process and Power programs to account for temporal count (process variation) and sampling variation. Temporal count variation is high when there are wide variations in mean fall densities over time. Sampling variation is high when there are wide count variations within a survey year. Total CV was input into TRENDS. Other TREND parameters include: an exponential model (changes in deer populations tend to be multiplicative rather than additive); a 2-tailed test because we are interested in decreases and increases in the population; an alpha level of 0.1; a 0.10 rate of change, and study duration (either 5 or 6 years depending on whether or not data was gathered during the fall of 2000).

SYSTAT PC was used to perform linear regression of the logarithm of the total population against time to check for significant population trends over time. A p-value of 0.01 was used instead of 0.05. The 0.05 level is typically used in scientific studies to guard against a Type I error (rejecting the null hypothesis when it is actually true – for our purpose, stating that there is a population trend when it does not exist). The p-value of a statistical significance test represents the probability of obtaining values of the test statistic that are equal to or greater in magnitude than the observed test statistic. A p-value close to zero signals that your null hypothesis is false, and typically that a difference (trend) is very likely to exist. Large p-values closer to 1 imply that there is no detectable difference for the sample size used (no trend exists).

There is a statistical and biological reason for using 0.01 instead of 0.05. When repeated measurements over time are collected from the same area, the count data can be correlated from one year to the next (serial or positive autocorrelation). The use of 0.01 can mitigate positive autocorrelation (Hatfield et al. 1996).

The biological reason for using 0.01 is that it can take 5-10 years for vegetation recovery to occur after deer densities have been reduced to acceptable levels (Niewinski et al. 2006). A significant population decrease at a significance level of 0.01 would be more congruent with lower deer densities and vegetation recovery (but would not guarantee vegetation recovery when densities remain above acceptable levels).

RESULTS and DISCUSSION

REGIONAL DENSITY RESULTS

Figure 1 shows the 2005 fall densities for all parks. All parks (except GWMP and PRWI) have deer densities that exceed 16 deer per square kilometer (40 deer per square mile). Densities above 40 deer per square mile indicate negative effects on other wildlife species; densities above 25 deer per square mile indicate a negative effect on vegetation (Tilghman 1989; deCalesta 1997).

Individual park results will be discussed in the 'Park Results' section below.

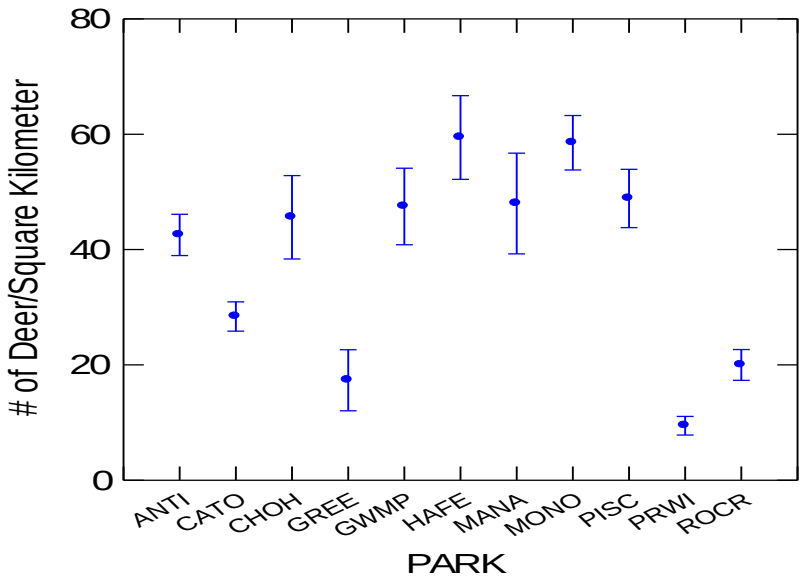

Figure 1. Fall 2005 deer densities at NCR parks. Blue dots indicate the mean; horizontal bars indicate the standard error of the mean.

SEX RATIO RESULTS

Table 2 contains buck:doe ratios from fall spotlight surveys. Buck:doe ratios of 1:4 or more may indicate an overpopulation situation (Miller and Marchinton 1995).

	2001	**2002**	**2003**	**2004**	**2005**
ANTI	1:9.00	1:5.22	1:3.06	1:3.54	1:8.12
CATO	1:13.00	1:3.11	1:7.03	1:9.30	1:12.2
CHOH	1:5.40	1:3.40	1:6.00	1:6.57	1:6.60
GREE	1:3.61	1:3.47	1:8.00	1:2.76	1:9.00
GWMP	1:4.92	1:5.23	1:2.33	1:23.00	1:5.90
MANA	1:9.66	1:5.75	1:7.09	1:4.00	1:8.50
MONO	1:11.40	1:5.22	1:6.13	1:7.12	1:6.50
PISC	1:5.41	1:2.70	1:7.83	1:4.52	1:8.00
PRWI	1:4.76	1:6.16	1:7.50	1:4.40	1:1.91
ROCR	1:2.87	1:5.30	1:2.69	1:4.76	1:3.26

Table 2. 2001-2005 buck:doe ratios.

Fawn: doe ratios (Table 3) of 0.3:1 or less indicate populations under stress (Miller and Marchinton 1995) (not enough desirable food sources for does to produce twins). Overall, 2005 had the lowest fawn:doe ratios of any survey year – 5 parks had their lowest ratios ever recorded. CATO, PRWI, GWMP, CHOH, and ROCR had values of 0.3:1 or less in 2005. PRWI and GWMP have had low fawn:doe ratios for 4 out of 5 survey years. CATO has had low ratios for 2 consecutive years while CHOH has had low ratios for 3 out of the 5 survey years. Poor visibility of fawns due to vegetation may be a factor at PRWI.

	2001	**2002**	**2003**	**2004**	**2005**
ANTI	0.74	0.91	0.86	0.80	0.41
CATO	0.37	0.44	0.41	0.30	0.08
CHOH	0.13	0.17	0.56	0.52	0.10
GREE	0.25	0.22	0.63	0.46	0.56
GWMP	0.23	0.28	0.76	0.26	0.03
MANA	0.63	0.27	0.45	0.34	0.35
MONO	0.66	0.93	0.87	0.59	0.38
PISC	0.37	0.48	0.86	0.69	0.62
PRWI	0.16	0.19	0.38	0.00	0.08
ROCR	0.12	0.25	0.75	0.39	0.30

Table 3. 2001-2005 fawn:doe ratios.

	% CHANGE[1]	**F-RATIO[2]**	**P-VALUE**	**%POWER[3]**
ANTI	21	1.55	0.30	70
CATO	-61	8.49	0.04*	100
CHOH	36	1.01	0.37	60
GREE	-49	0.03	0.85	34
GWMP	40	0.04	0.84	21
HAFE	11	0.01	0.92	16
MANA	-16	0.43	0.54	97
MONO	-1	0.61	0.49	95
PISC	13	0.17	0.70	58
PRWI	-39	7.63	0.06	18
ROCR	-16	0.02	0.87	42

Table 4. Percent population change, linear regression f-ratio, and p-value.
1- First year density divided by last year density.
2- Linear regression test statistic.
3- 80% power to detect a ±10% trend.
*- Significant p-value at the 0.05 level.

PARK RESULTS

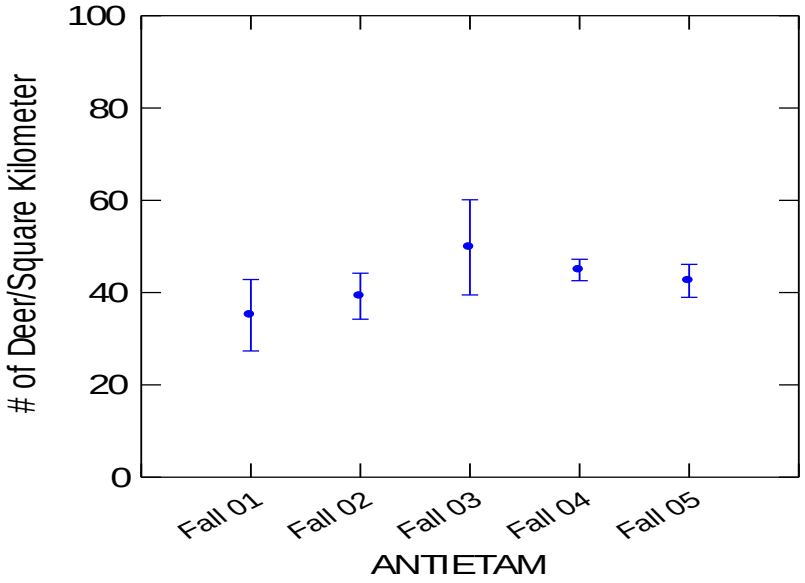

Figure 2. Antietam National Battlefield mean density data.

If bars overlap then there is no significant difference between years. The 2005 deer density was the second decrease after two years of increases. There was no significant population trend from 2001-2005 (Table 4). The park will have 80% power to detect a trend of ±10% after the 2006 survey.

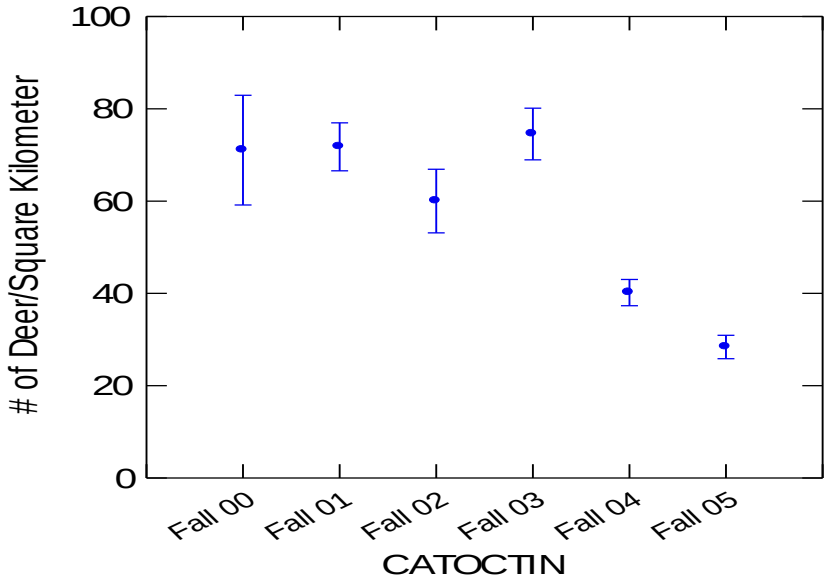

Figure 3. Catoctin Mountain Park mean density data.

The mean fall density decreased significantly for the second straight year. This may be due to a combination of factors: poor habitat conditions from 25 years of an overpopulation condition, disease, increased hunting/depredation pressure outside of the park, and predation by coyotes (primarily) and black bears (rarely). Similar decreases occurred after the winters of 1993-1994 and 1995-1998; the population quickly rebounded.

The decrease in the population during the period of study (2000-2005, Table 4) was not significant at the 0.01 level but is significant at the 0.05 level. If the density remains under 37 deer/square kilometer (95/square mile) in 2006, the decrease in the population will be significant at the 0.01 level.

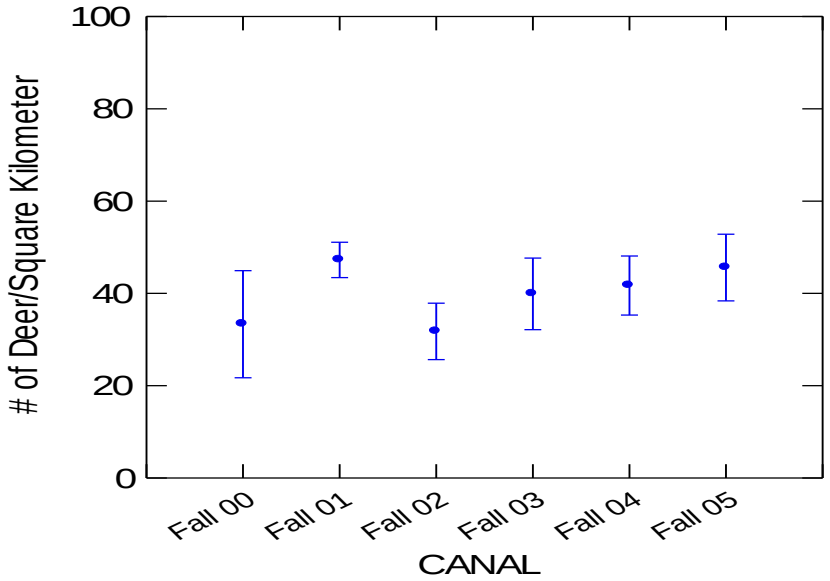

Figure 4. CHOH (Goldmine Tract) mean density data.

Densities at C&O have been fairly stable when compared to other parks (a range of 16 between the lowest and highest densities). There was no significant population trend during the study period (2000-2005, Table 4). The park will have 80% power to detect a ±10% trend in 1 year.

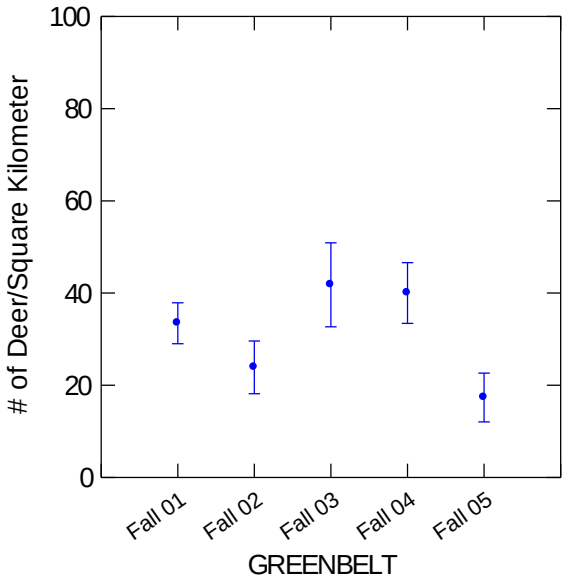

Figure 5. Greenbelt Park mean density data.

There has not been any significant trend at Greenbelt during the study period (Table 4). The park has low power to detect a trend (Table 4). Year-to-year variation (55% of the total variation) was the primary factor. It will take 3 more years of surveys before the park reaches 80% power to detect a trend.

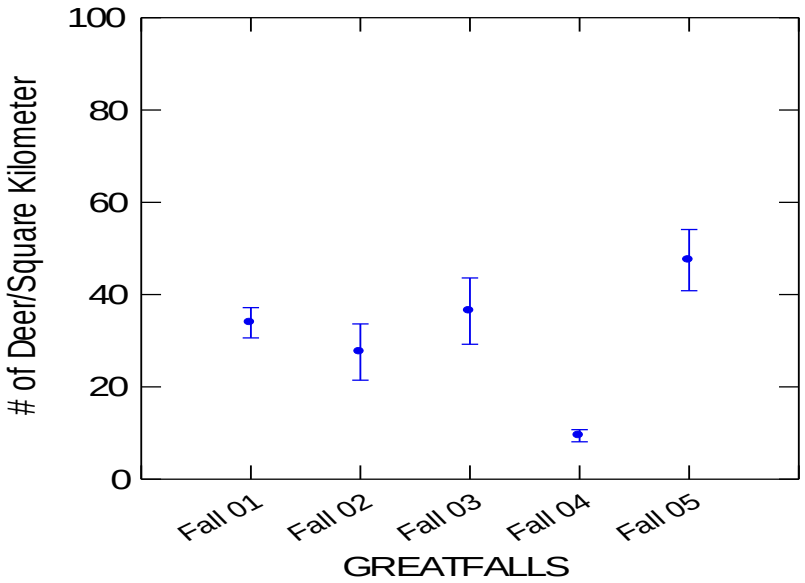

Figure 6. Great Falls mean density data.

There was no significant trend in the deer population (Table 4). The park also has low power to detect a trend (Table 4). Year-to-year count variation was responsible for 89% of the total variation. This can be seen looking at the mean fall densities from 2001-2005 (33, 27, 36, 9, and 47). It will take another 5 years of surveying before 80% power is achieved. Deer may have moved away from Great Falls during the Riverbend Park culling operation in 2004. Future spotlight surveys have to be conducted before culling begins in order to achieve accurate results or another method (digital camera surveys) may have to be used to assess the approximate deer density.

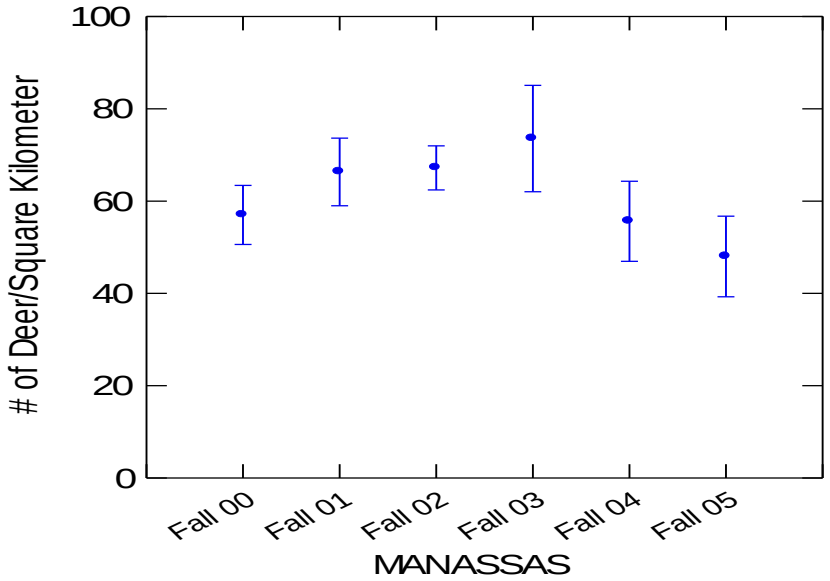

Figure 7. Manassas National Battlefield Park mean density data.

Manassas experienced slight non-significant decreases in 2004 and 2005. No significant trend was detected during the study period (2000-2005, Table 4). MANA has achieved 100% power to detect a ±10% trend.

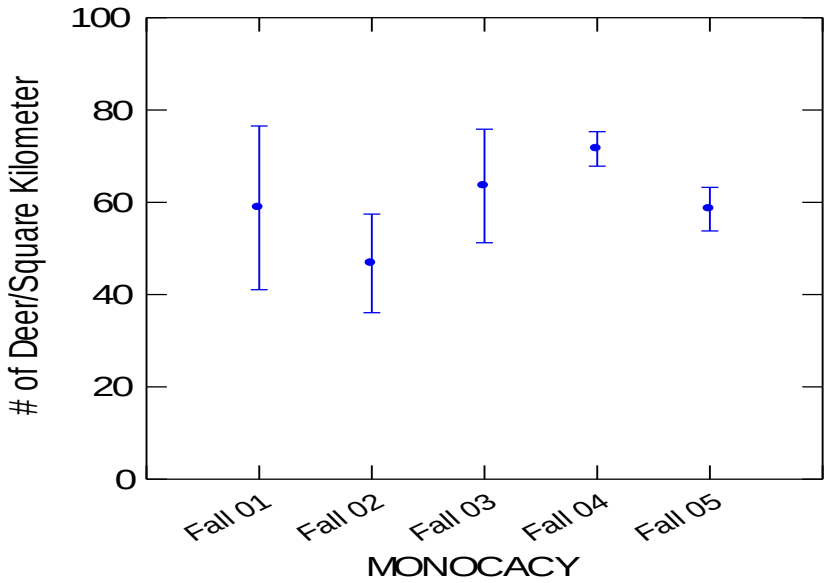

Figure 8. Monocacy National Battlefield mean density data.

Monocacy's deer density decreased slightly from 2004. The park had the second highest density in the region in 2005. It has been one of the top 3 high-density parks in each year of the survey. There was no significant population trend during 2001-2005 (Table 4). The park has 95% power to detect a ±10% trend after the 2005 surveys.

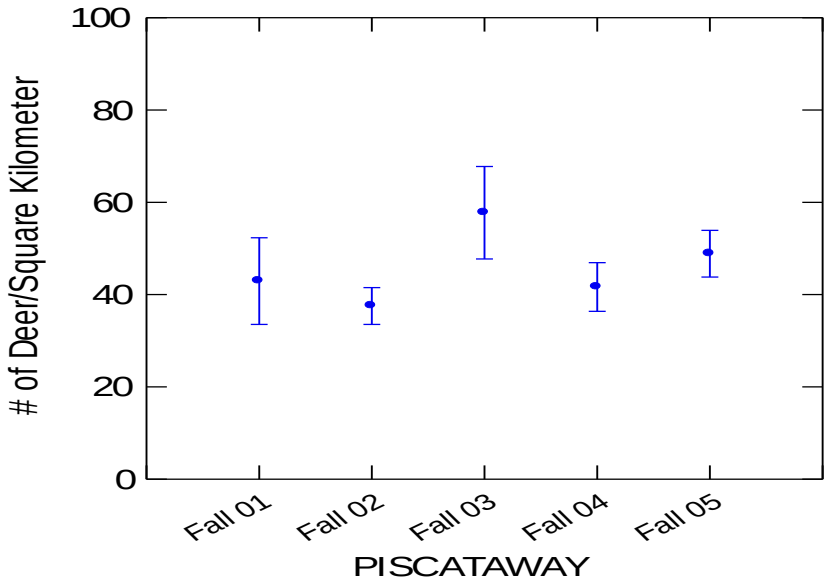

Figure 9. Piscataway Park mean density data.

The deer density at Piscataway continued to exhibit a zigzag, up-down pattern. There was no significant population trend from 2001-2005. Power to detect a trend is now 58% and should be over 80% after the 2006 survey (Table 4).

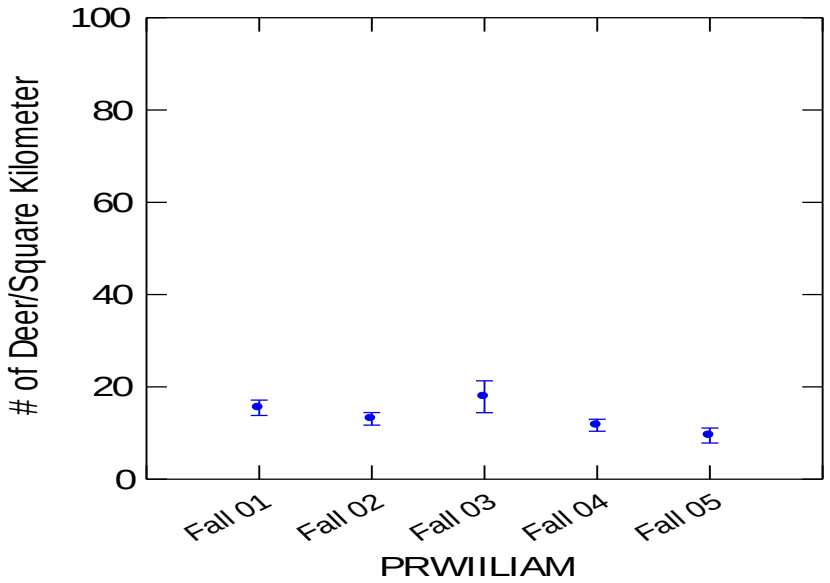

Figure 10. Prince William Forest Park mean density data.

Density at Prince William decreased slightly in 2004 and 2005. With the exception of 2003, the deer population has been less than 16 deer/square kilometer (40 per square mile). No discernible trend was detected though power to detect a trend remains low (Table 4). Sampling variation and year-to-year variation account equally for the total count variation. It will take another 5 years of surveying before the park reaches 80% power. The relatively high amount of variation in 2003 has kept the power to detect a trend quite low. Increasing the number of spotlight surveys to increase the power to detect a trend would be easier than using digital camera surveys. It would take 150 digital cameras to conduct an accurate deer density survey at the optimal density of one camera per 160 acres throughout the park.

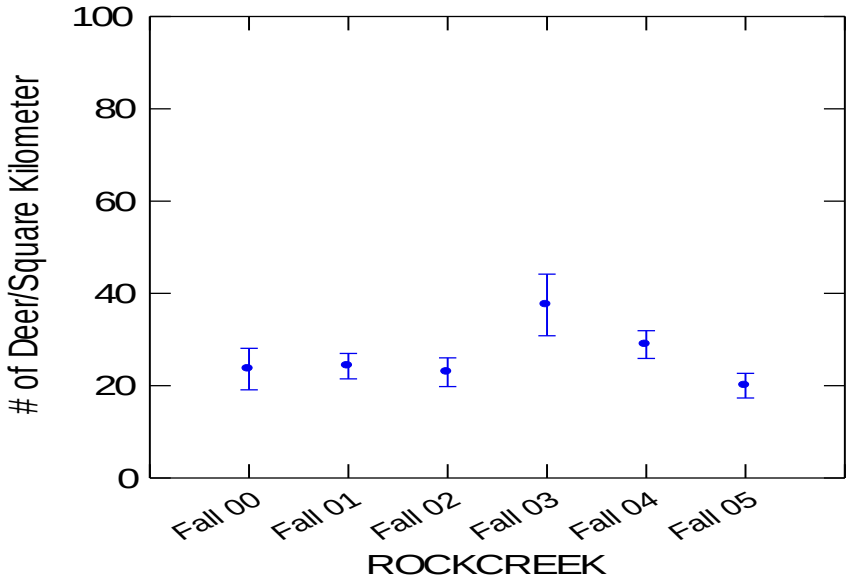

Figure 11. Rock Creek Park mean density data.

Rock Creek experienced a slight decline in 2004 and 2005. There have been no significant trends in the population. Power to detect a trend remains low (42%) because of the increase in the survey in 2003 of sampling variation and temporal count variation. The breakdown of their contribution to the total variation was 53% and 47%, respectively. The park will reach 80% power to detect a trend in 3 more years.

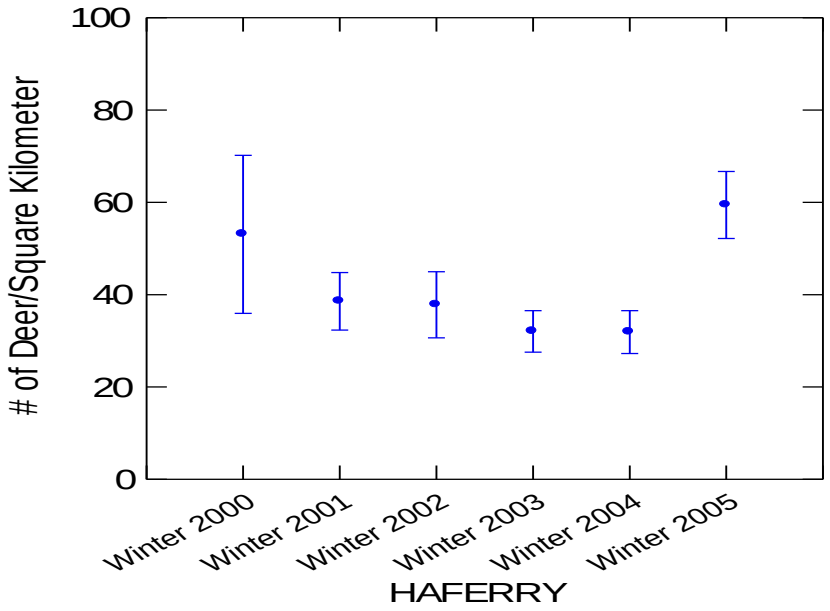

Figure 12. Harpers Ferry National Historic Park mean density data.

Deer density increased to a 6-year high after decreasing for 4 consecutive years. Power to detect a 10% change in the population is low (16%). The reason for this is extremely high sampling variation which comprised 98% of the total variation. This is typical for an indice technique. Either the number of plots should be increased or another technique (digital camera stations) should be considered.

In 2006 the park will be using SPIN funding to use the pellet-group indice throughout the park. Regeneration plots will also be established throughout the park. The number of pellet-group plots will be increased to a density of one plot per 10 acres to decrease the sampling variation. The current density is one plot per 15 acres.

CONCLUSIONS

Deer Density

All but two of the parks surveyed had overabundant deer populations (>40 per square mile). Only GREE and PRWI had densities less than 40 per square mile, and PRWI exceeded this in 2003. All of the parks in the survey have completed or implemented deer impact studies except for GREE.

Power to Detect Population Trends

Three parks (MANA, CATO, and MONO) have achieved high power to detect small trends after five years of surveying. The remaining parks are listed in ascending order of additional years of surveying: ANTI, PISC and CHOH (1); ROCR (2); GWMP and PRWI (5); GREE (7), and HAFE (13). GWMP, GREE, and HAFE failed to increase their power to detect trends when compared to the 2004 survey. After 5 years of conducting DISTANCE at GWMP and GREE and 6 years of conducting pellet-group surveys at HAFE, it may be time to consider using digital cameras to calculate population density.

Public Interest Highlights

- Nine of the eleven parks surveyed have deer populations deleterious to other native plant and animal species.
- PRWI and GWMP (Great Falls) have densities less than 40 deer per square mile.

Management Recommendations

- HAFE should increase the number of pellet-group plots or use a mark-recapture method utilizing remote cameras.

Research Recommendations

- The first year of data collection for the DISTANCE road bias project has been completed at ANTI and CATO.
- The first year of data collection for the Potomac Gorge deer impact project has been completed.

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